Validation, Day of Week and Seasonal Perspectives on Satellite NO_2

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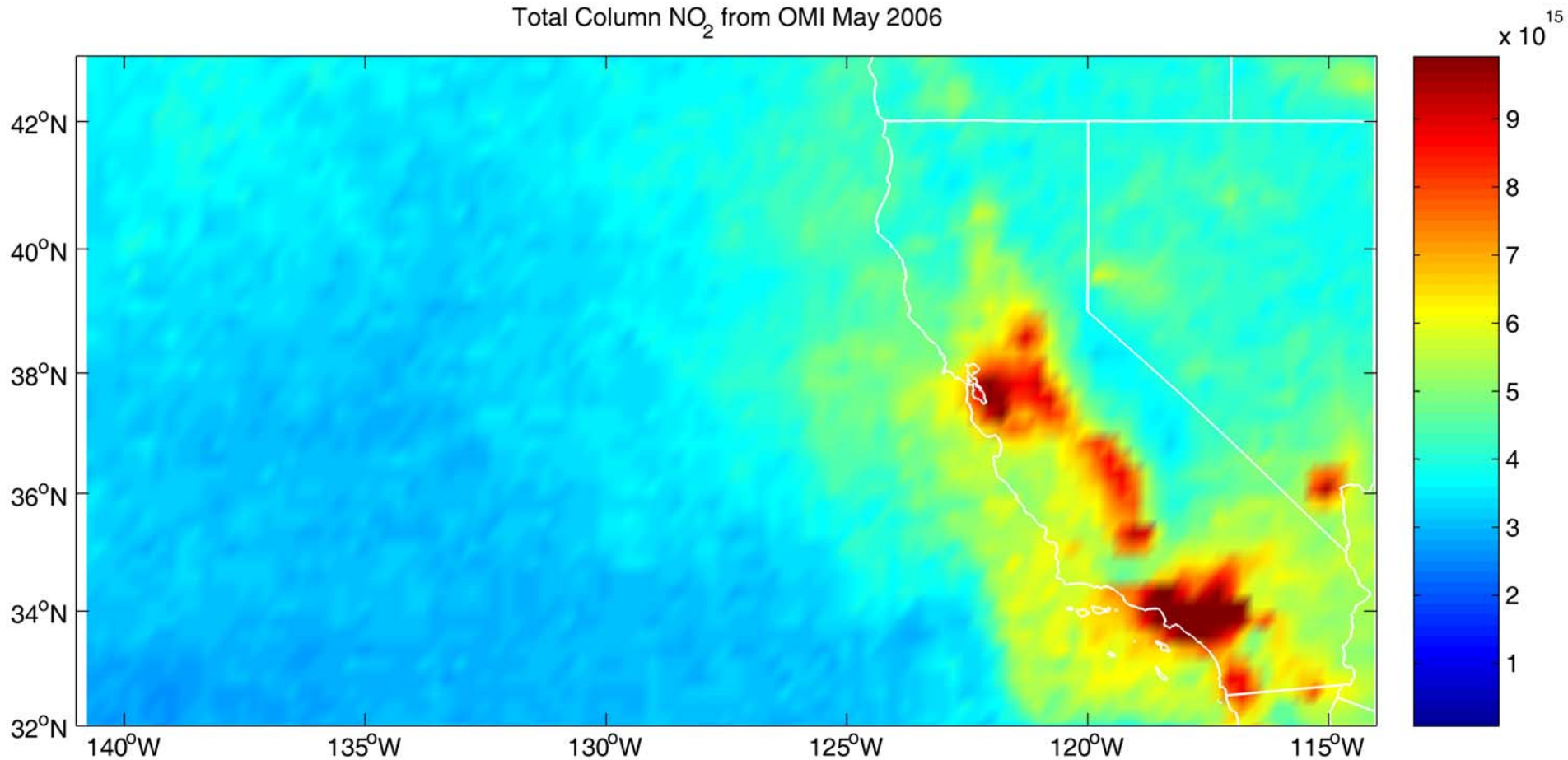
UC Berkeley

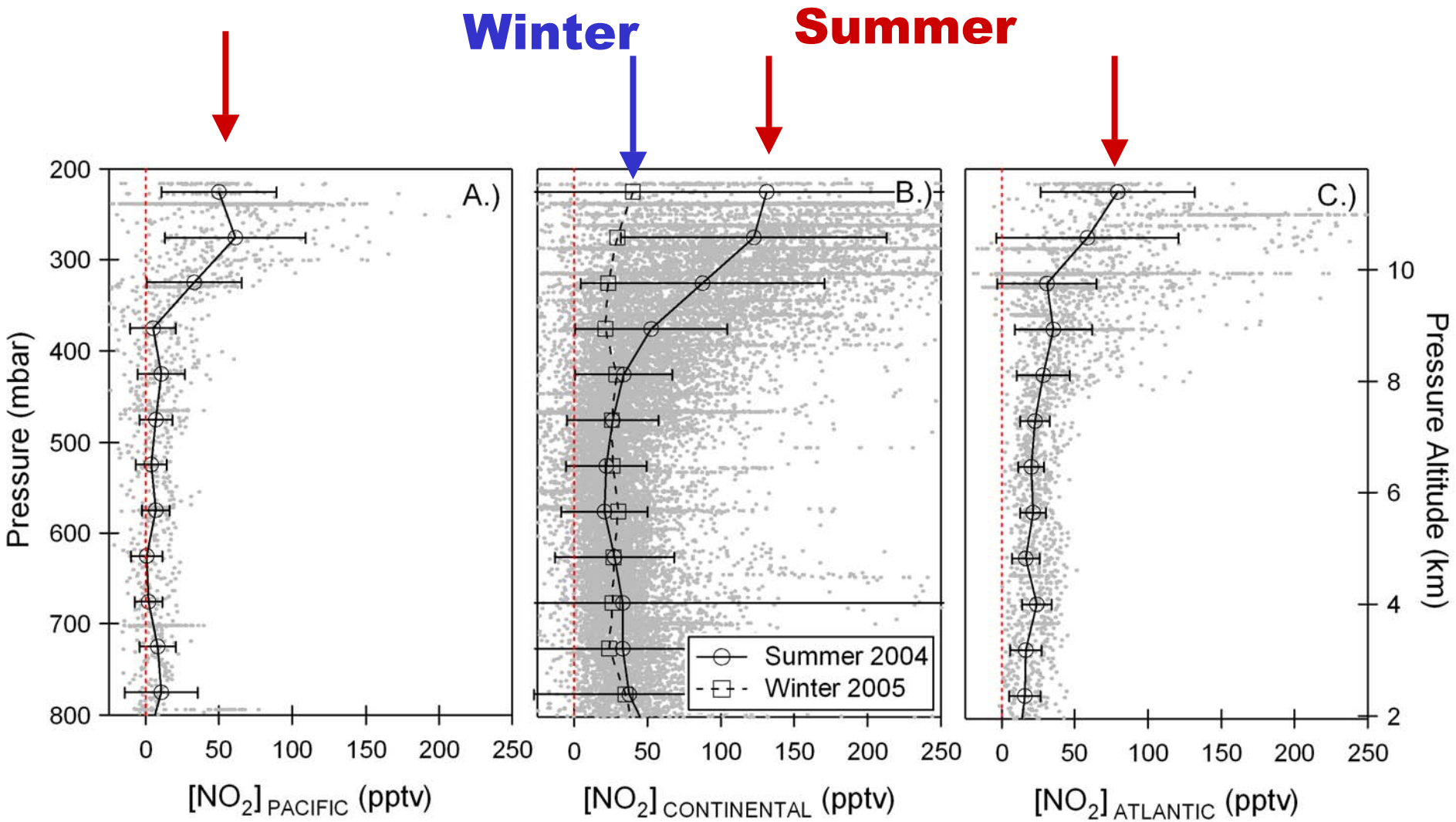


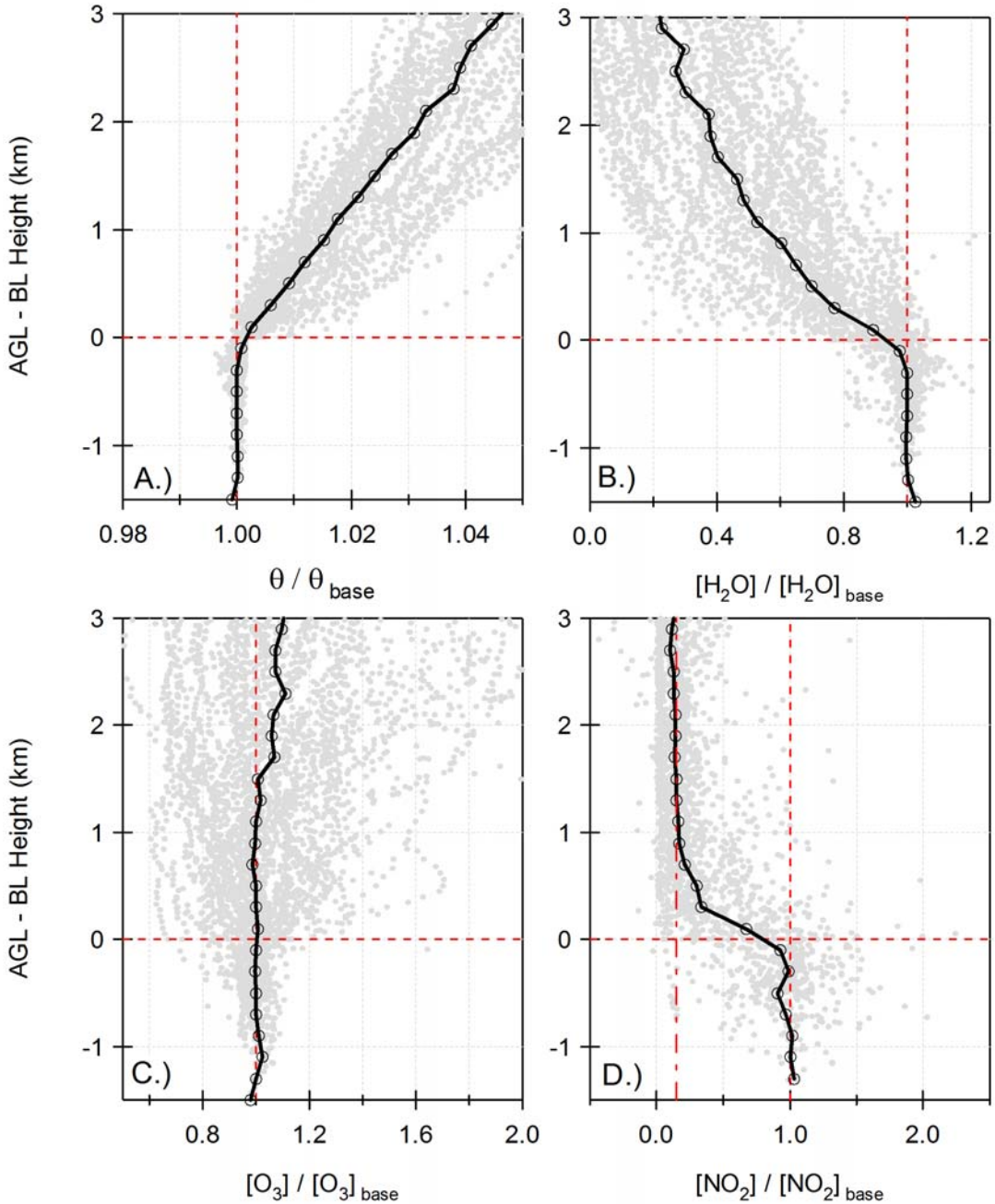
- **We need to become the AQ community and they need to be integrated with us. As long as it is "us" and "them" we are failing.**

- **To date the "AQ" data has been best digested by colleagues in a position to look at the whole globe. There has been relatively little work that takes advantage of the daily coverage or high spatial resolution.**

- **The California Air Resources Board is supporting use of OMI to identify strategies for producing high spatial resolution NO_x inventories with day-of-week information.**

In situ measurements of NO_2 profiles


Winter
Summer
A.)
B.)
C.)
Pressure (mbar)
Pressure Altitude (km)
200
300
400
500
600
700
800
2
4
6
8
10
0
50
100
150
200
250
Summer 2004
Winter 2005
[NO2] PACIFIC (pptv)
[NO2] CONTINENTAL (pptv)
[NO2] ATLANTIC (pptv)


AGL - BL Height (km)
A.)
B.)
C.)
D.)
θ / θ base
[H2O] / [H2O] base
[O3] / [O3] base
[NO2] / [NO2] base

INTEX-A DC-8

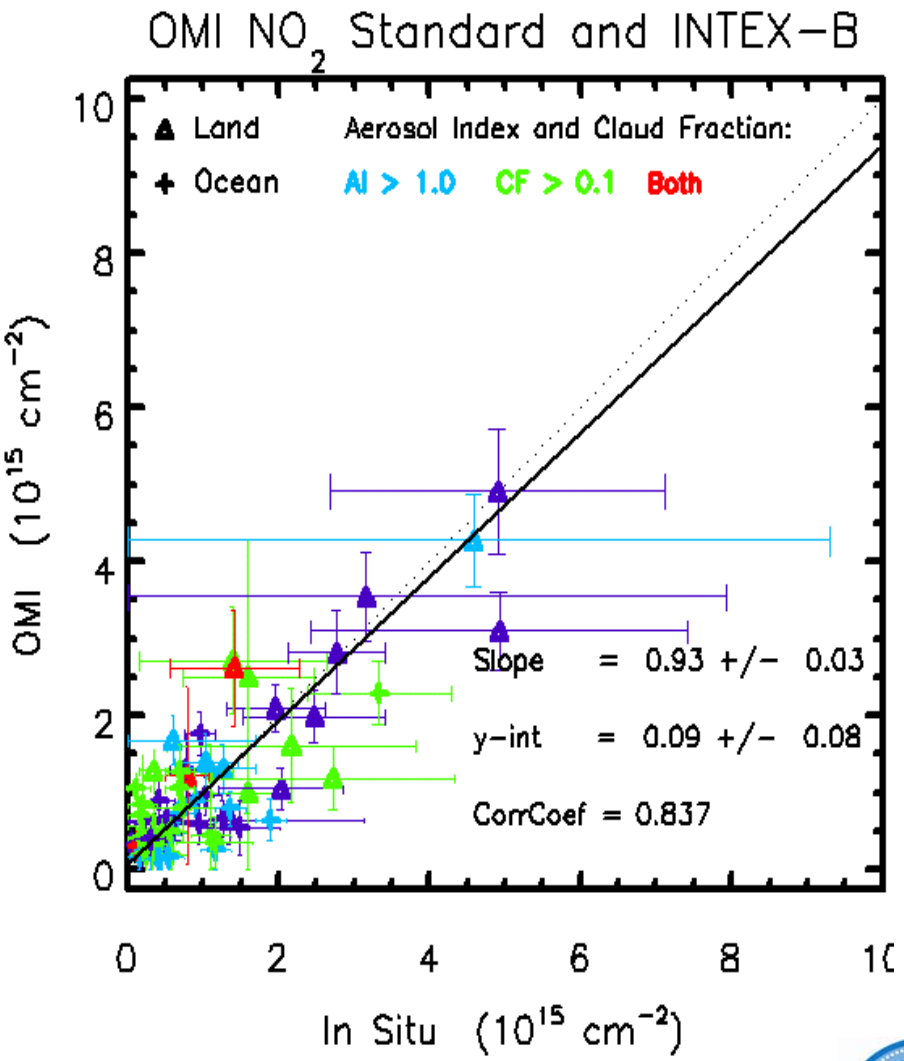
NO_2 Satellite Comparison

See papers by

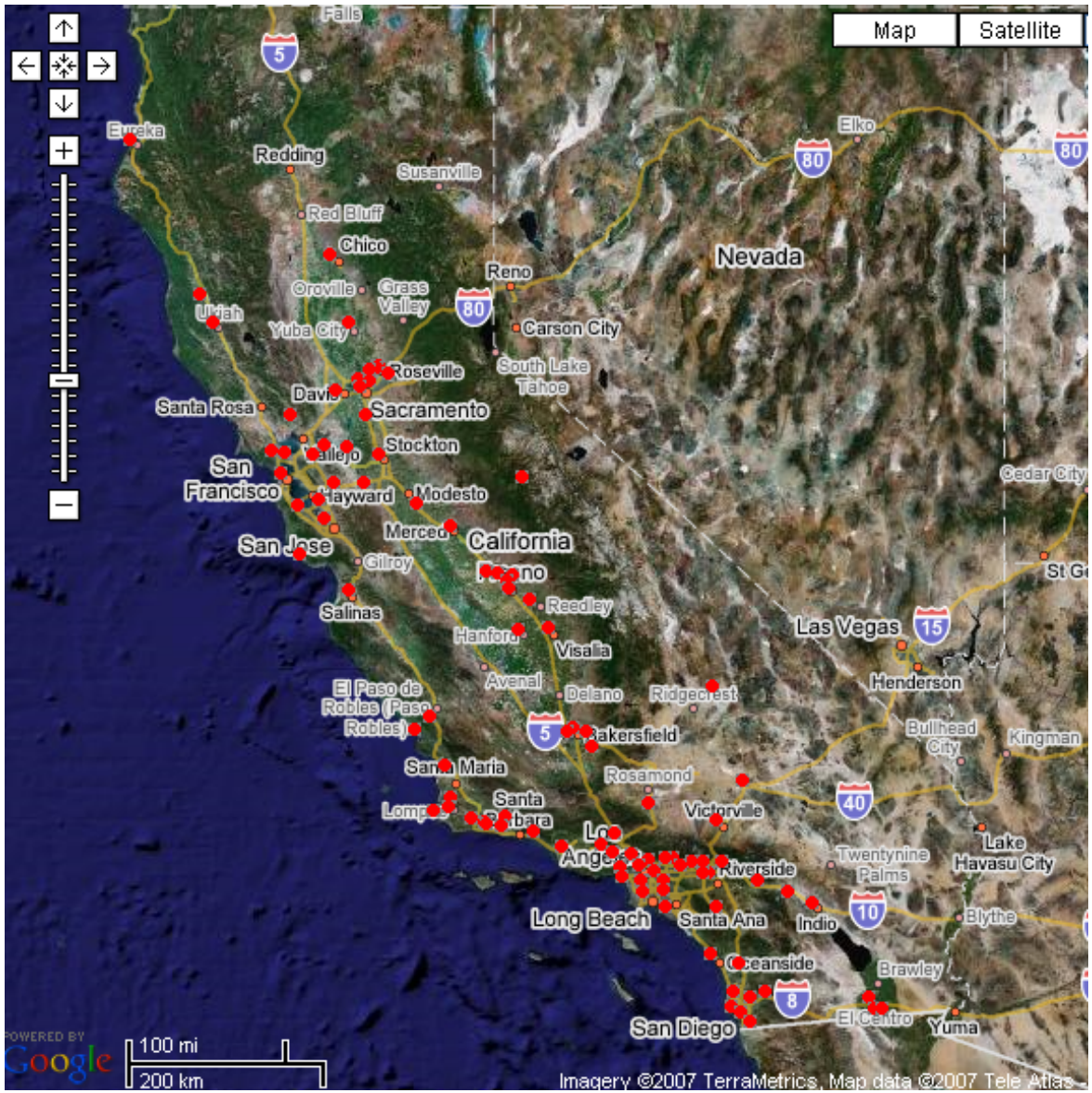
Bucsela et al.
Boersma et al.

in Aura special issue of JGR

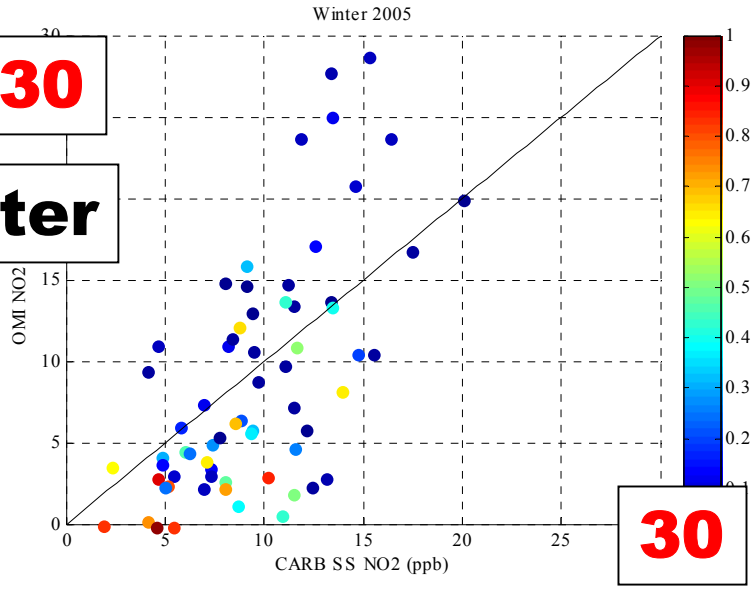
Profiles available in an excel spreadsheet, send me an e-mail

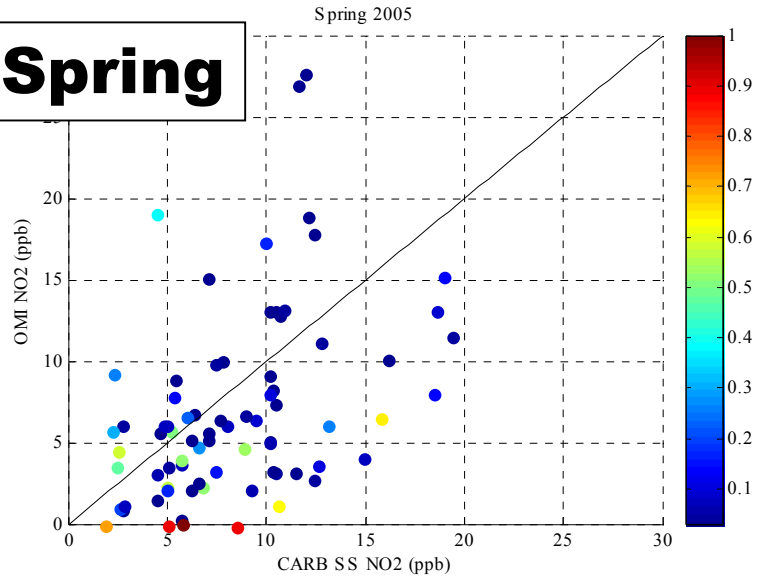


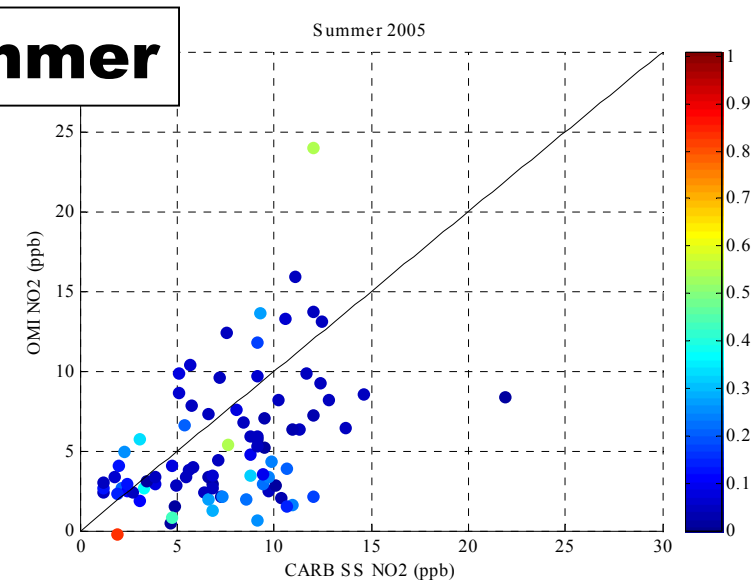
CARB Sites Measuring NO and O_3

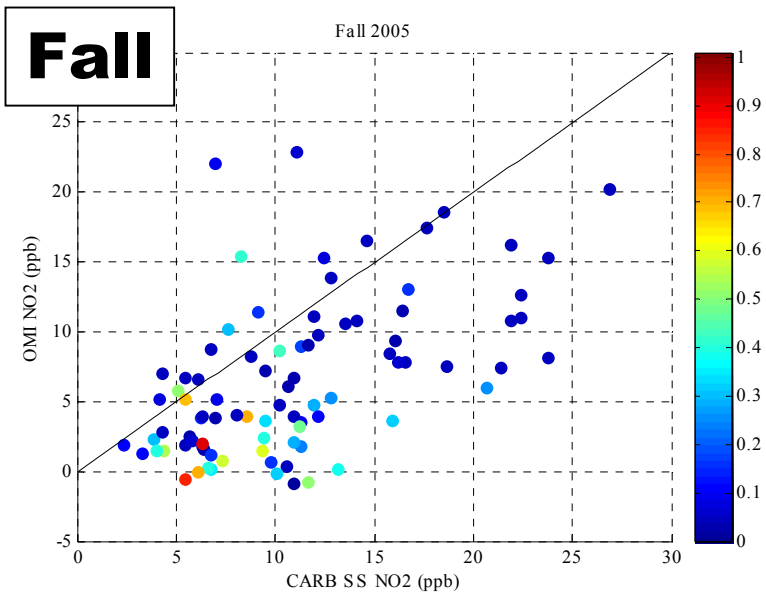


CARB NO2 PSS and OMI
Site 2125—Redwood City (near San Francisco)

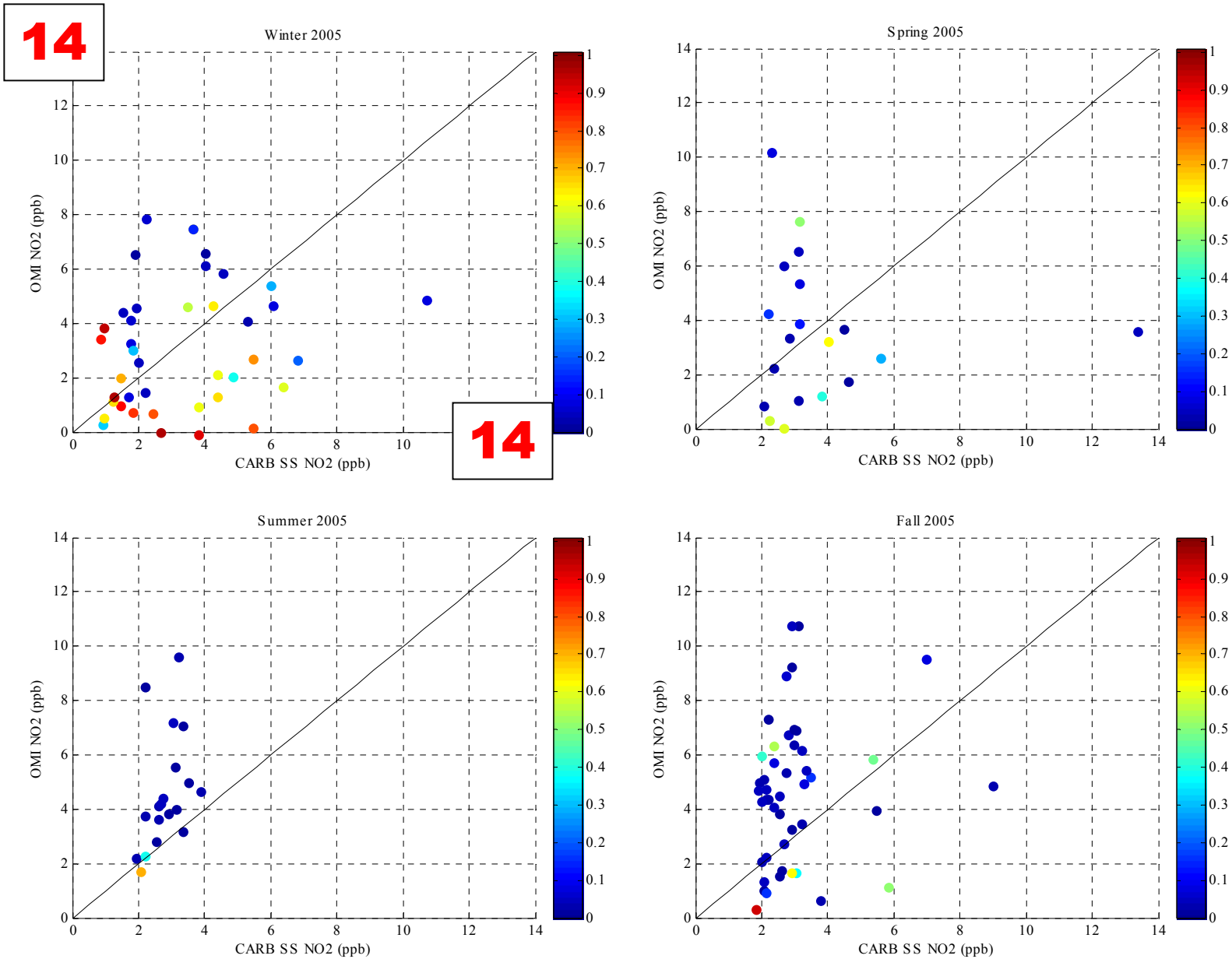




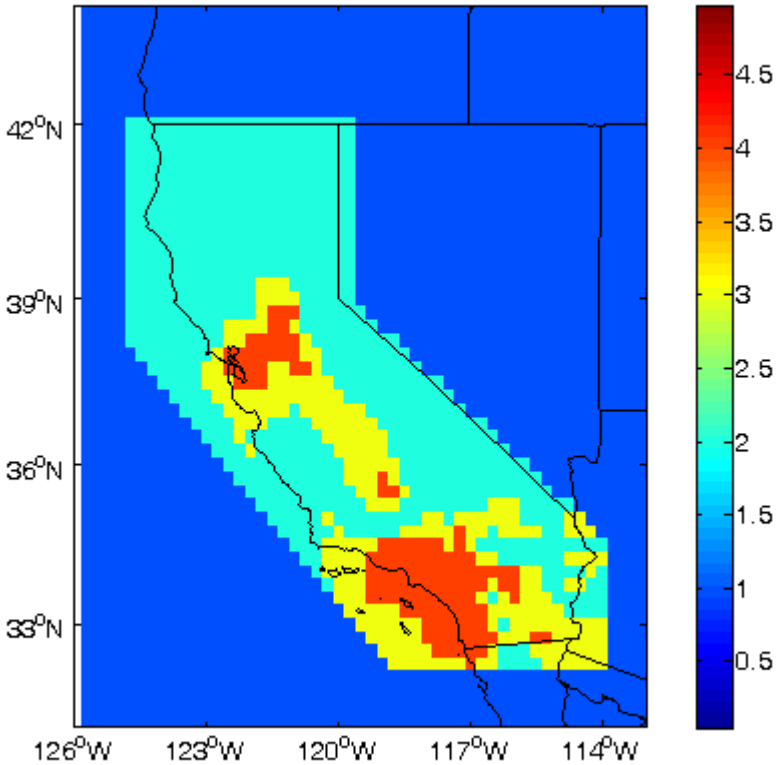




CARB NO2 PSS and OMI Site 2143 UC Davis



Winter (DEC/JAN/FEB) 2006

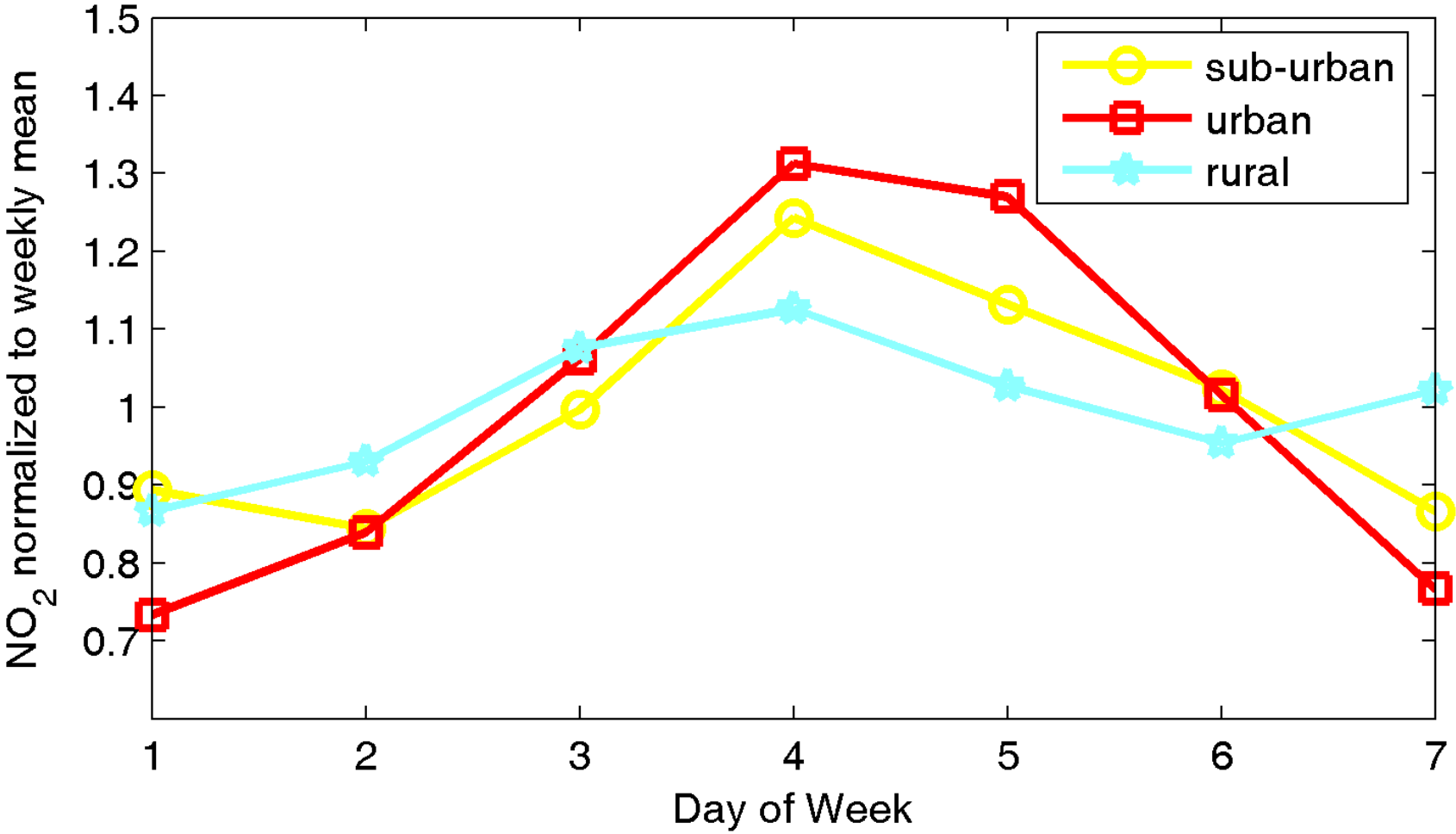


"Rural" California = cyan
winter average < 2E15 mol NO_2 cm^{-2}

"Sub-Urban" California = yellow
2E15 < winter average < 5E15 mol NO_2 cm^{-2}

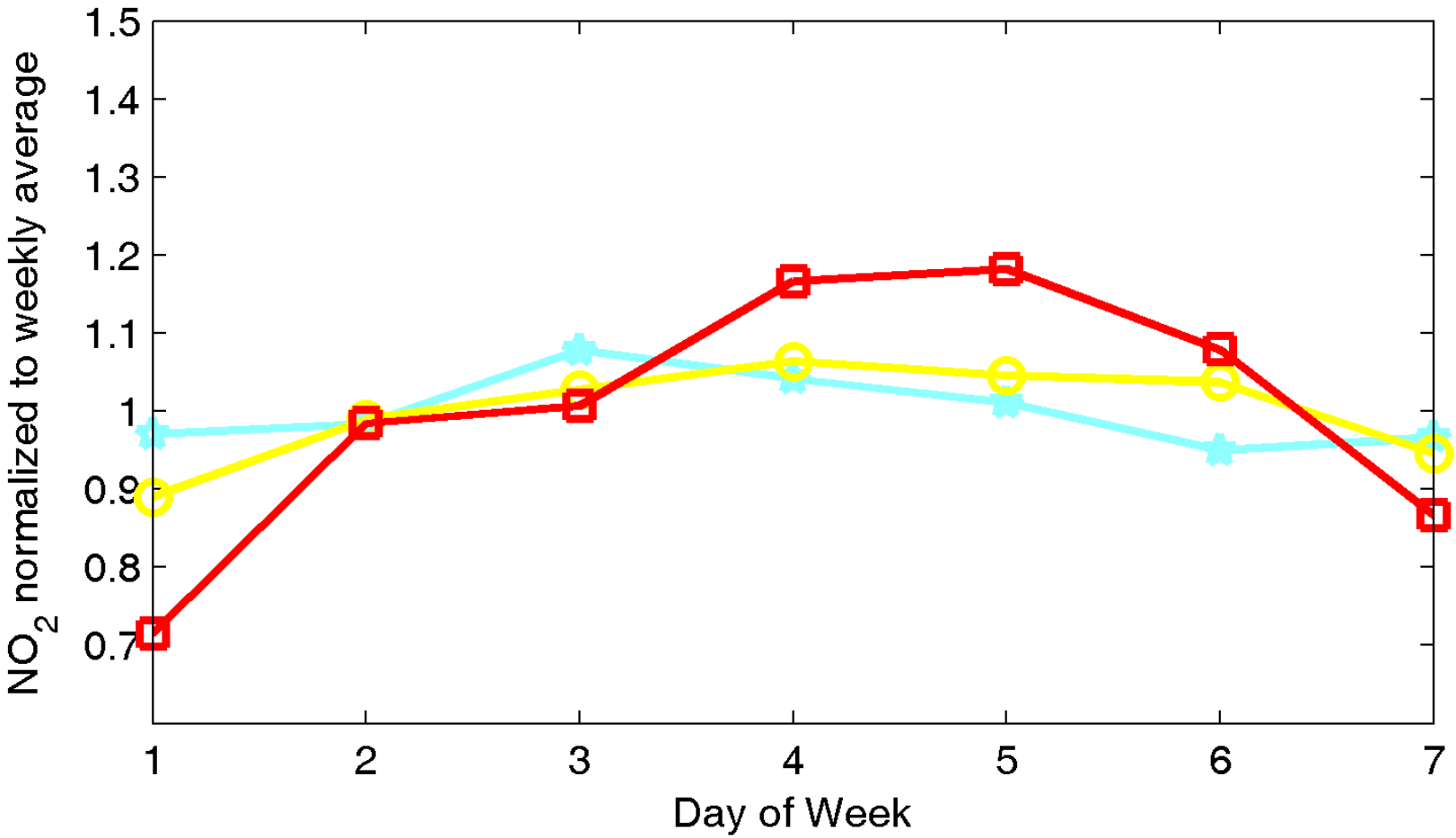
"Urban" California = red
winter average > 5E15 mol NO_2 cm^{-2}

Spring



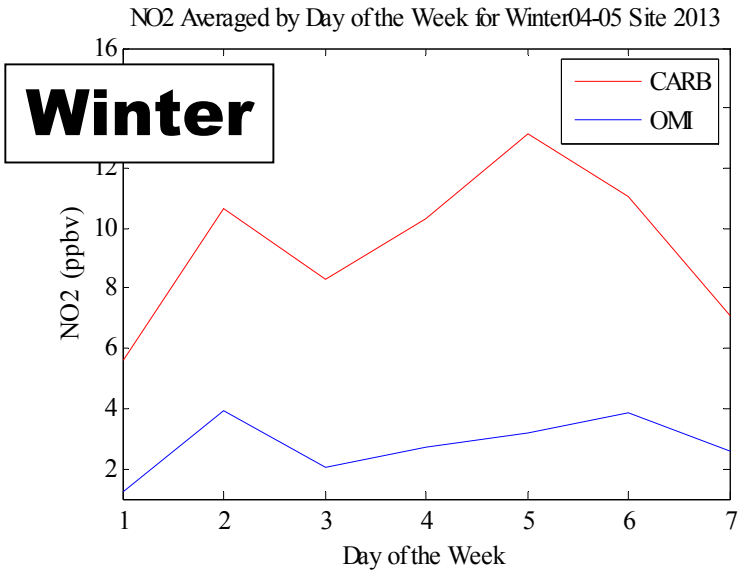
Sun **Weds** **Sat**

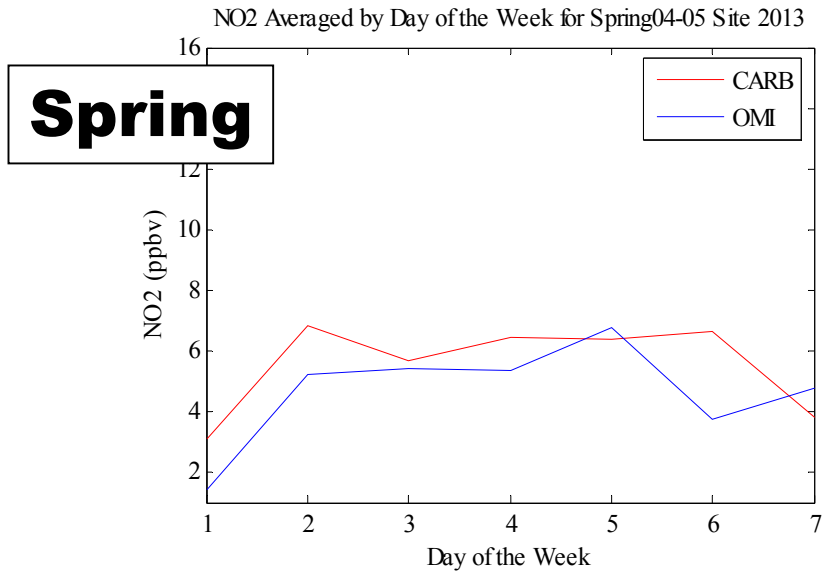
Summer

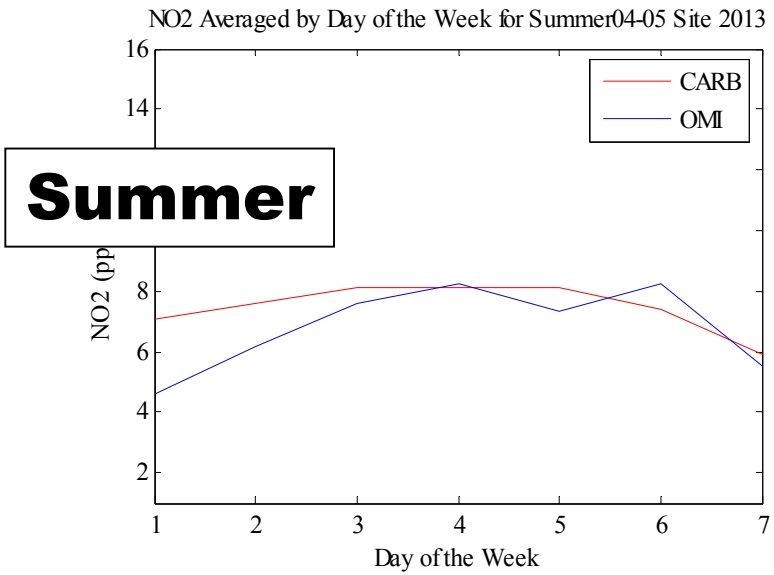


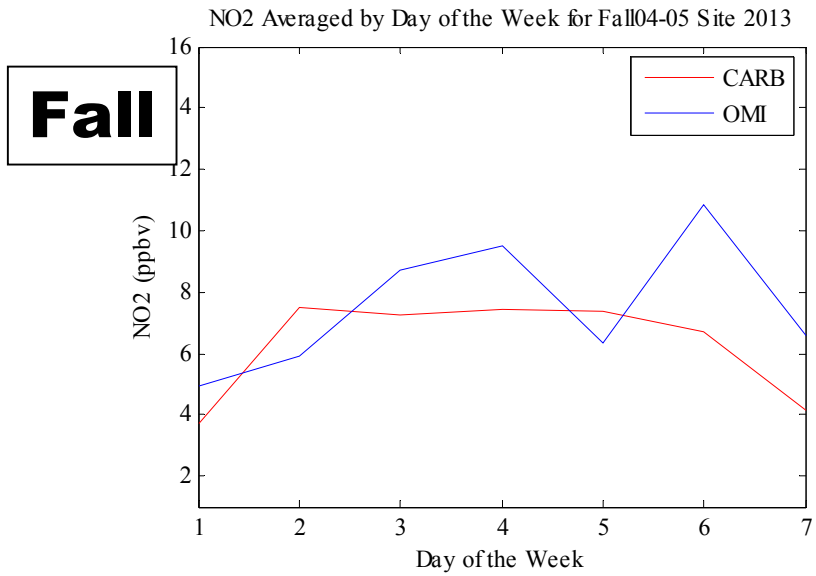
Sun **Weds** **Sat**

Day of the Week Variation by Season OMI







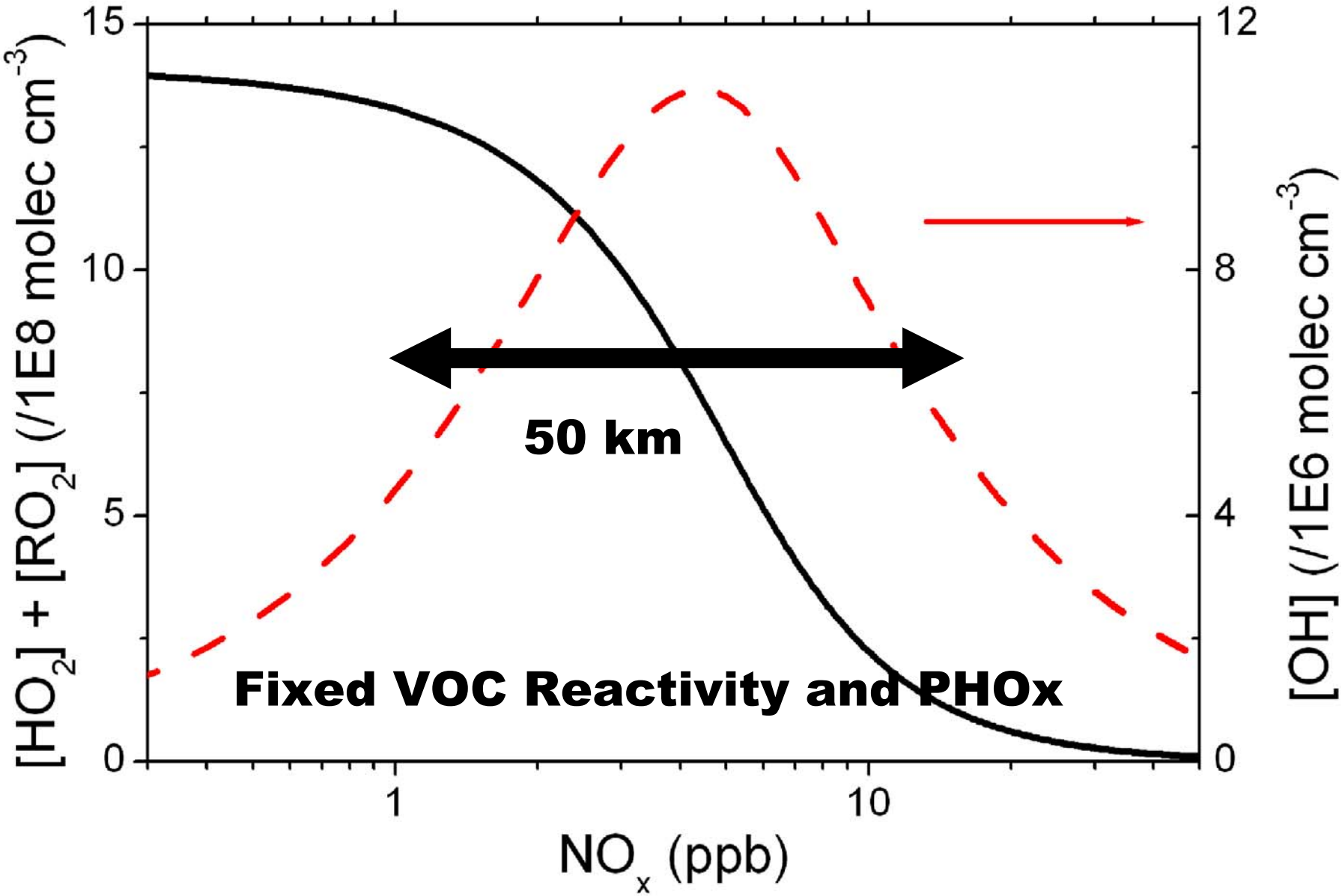


Fitting to an emissions inventory that doesn't vary by day of week introduces a bias (and one that will be different for models with large pixels sizes (sizes large compared to τ_{NO2}) than models with small pixel sizes.

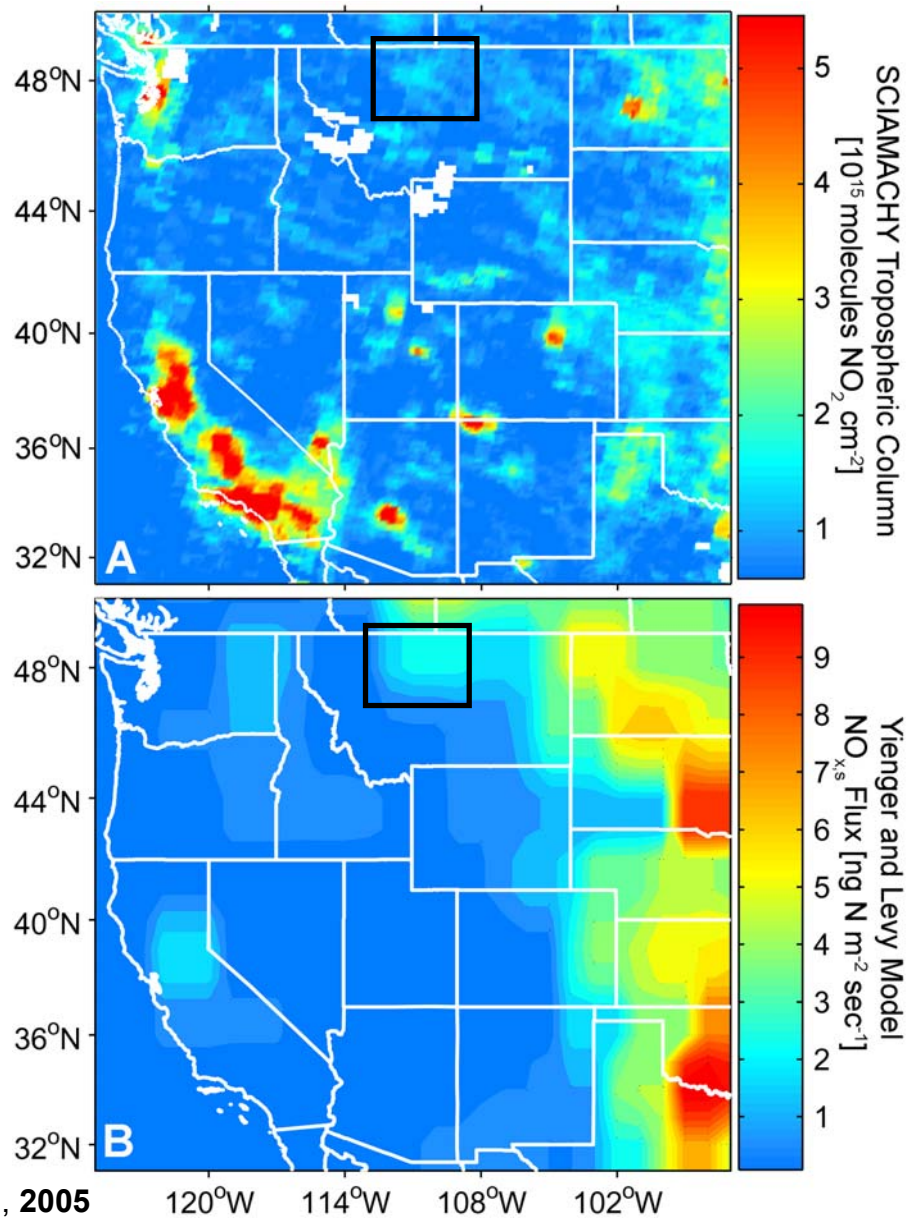
OH depends on NO_2 and therefore the NO_2 lifetime depends on NO_2.

Also $NO_2 + O_3$ can contribute—especially in winter and this rate is maximum when $NO_2 = O_3$ and will be underestimated in large scale models.

Concentrations of HO_x

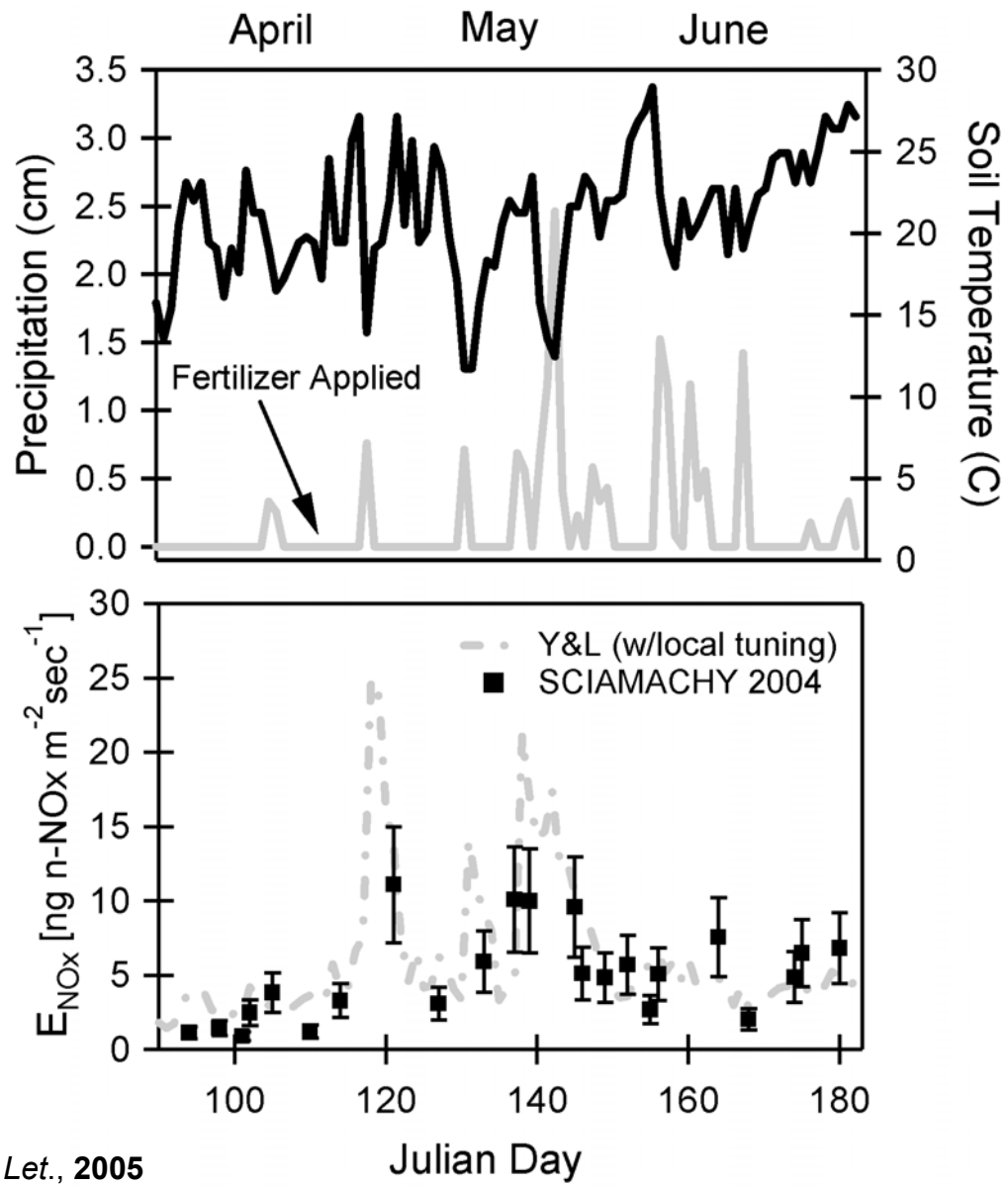


Satellite Constraints on Soil NO_x Emissions



Bertram et al., *Geophys. Res. Let.*, **2005**

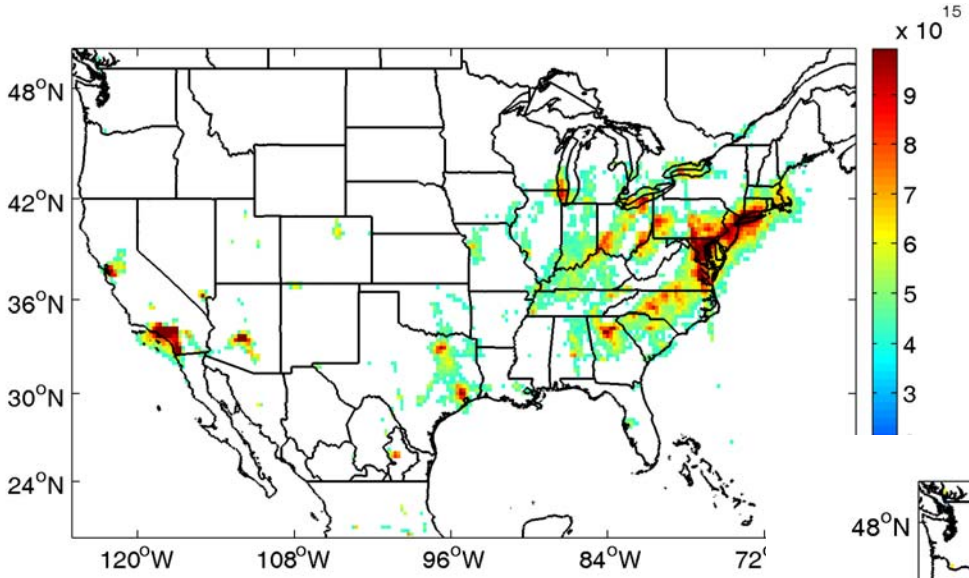
Soil NOx Emissions



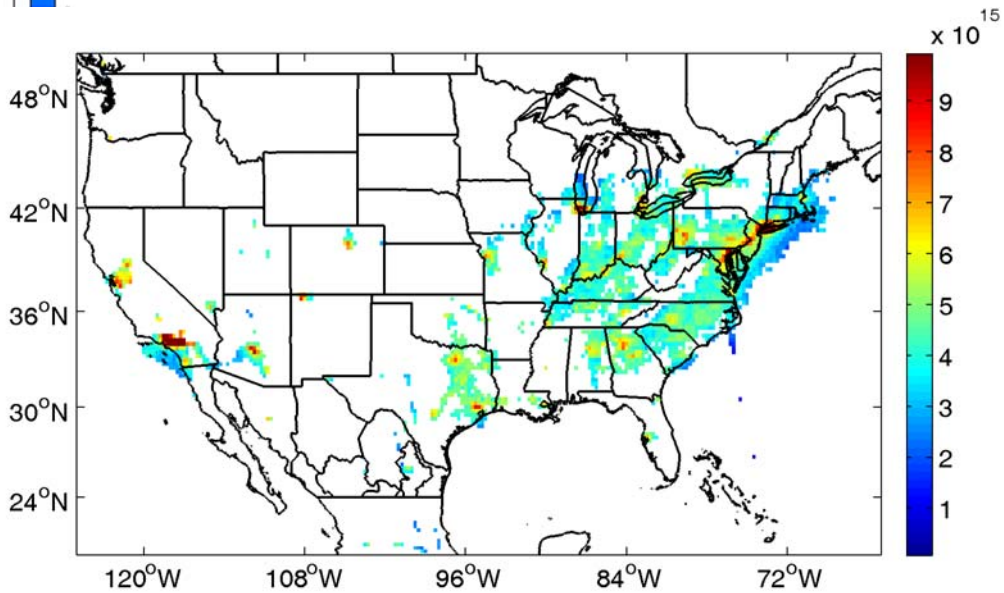
Bertram et al., *Geophys. Res. Let.*, **2005**

Urban Emissions

Winter

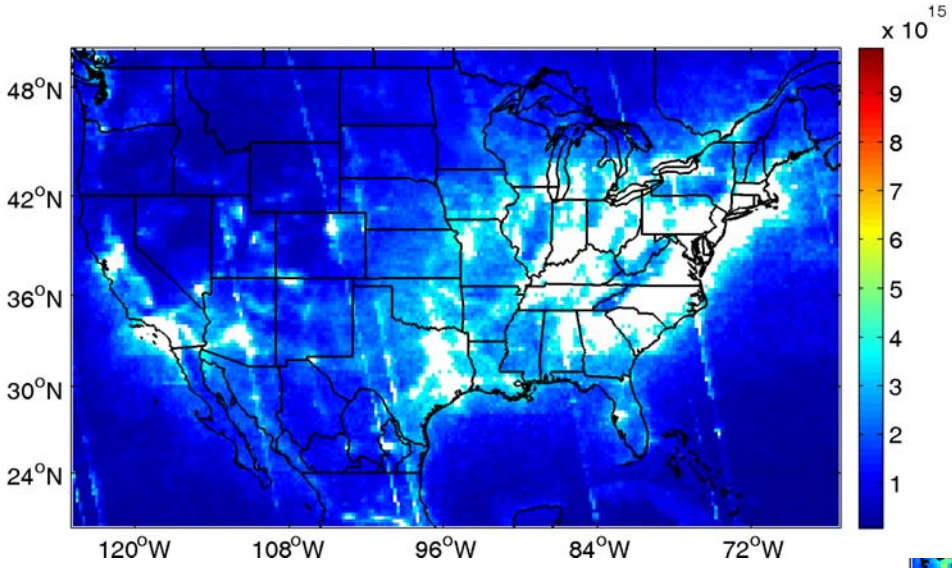


Summer

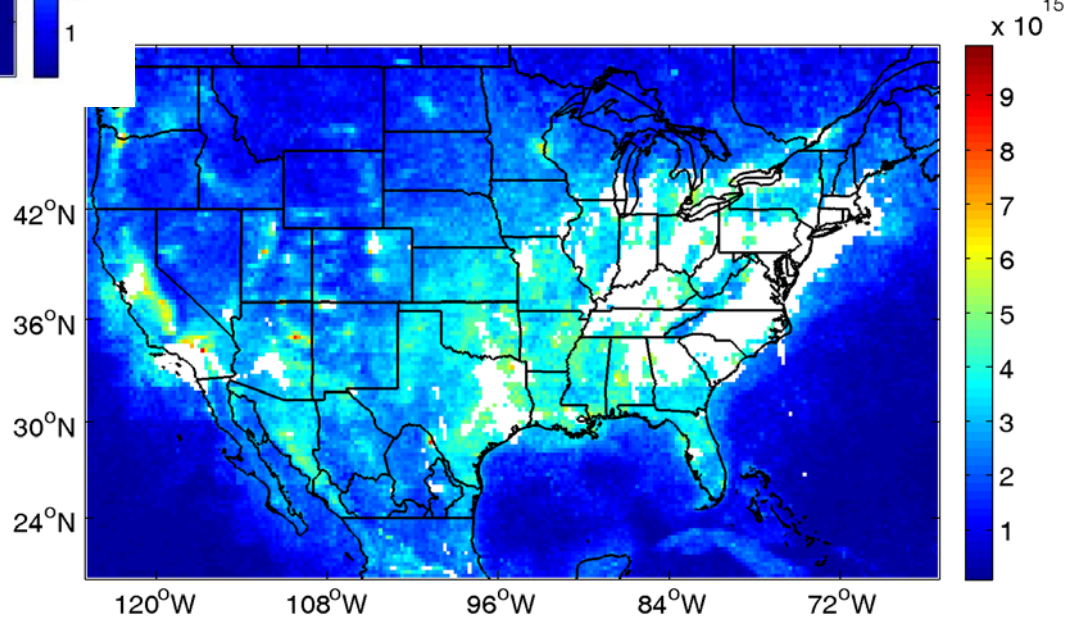


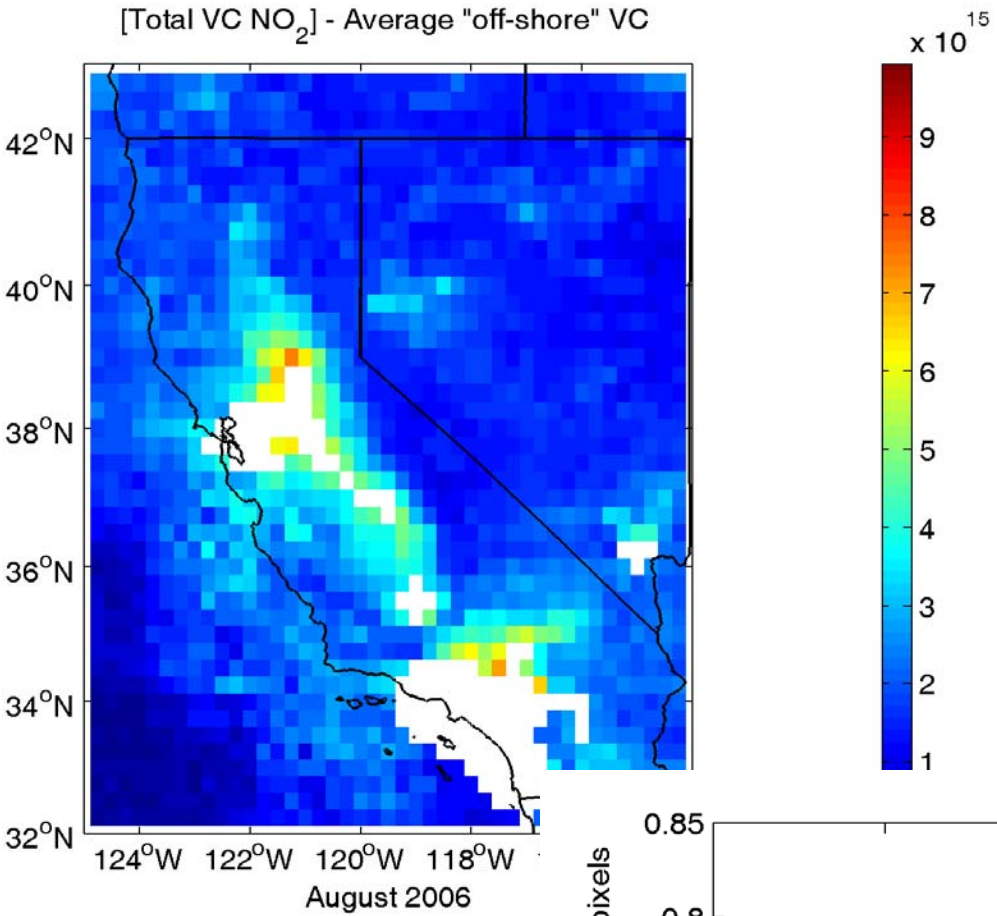
Rural locations: Agricultural Emissions&Lightning

Winter

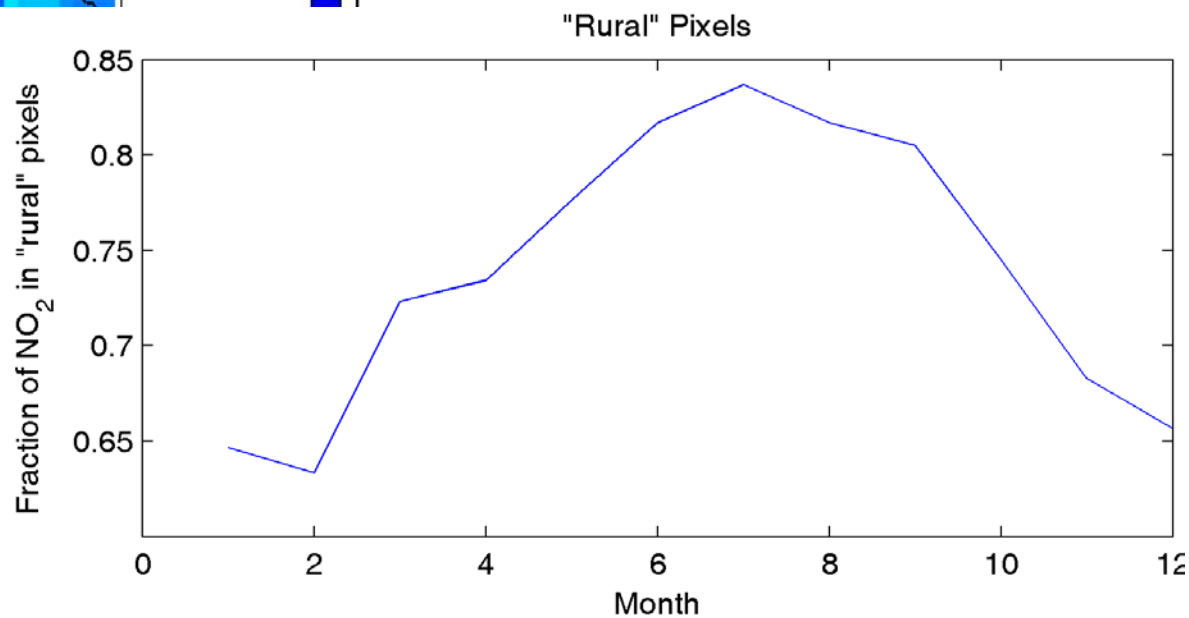


Summer





Summer Rural Pixels



Conclusions/Ideas

• NO/NO_2 photostationary state is likely a more accurate way to calculate surface NO_2 from the monitoring network than using a model of NO_z. In any case it is model independent and preserves some separation between data and models.

•OH and NO_2 are strongly coupled on spatial scales of a single OMI/SCIA/GOME-II pixel.

• Day of week variation can teach us a lot about sources and the quality of retrievals—since some factors are not strongly correlated with day of week; AMFs, stratosphere, etc.

•Seasonal variations provide strong hints about soil emissions. More analysis of mechanisms needed.

Thanks to Jim Gleason, Eric Buscela, Folkert Boersma, Andreas Richter, John Burrows

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